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N° 5700 A.D. 1891

Date of Application, 2nd Apr., 1891—Accepted, 17th Oct., 1891

COMPLETE SPECIFICATION.

Improvements in the Production of Ferments and of Fermented Alcoholic Liquors.

I, JOKICHI TAKAMINE, of 25 & 26 Honore Buildings Chicago, County of Cook, State of Illinois, United States of America, Chemist, do hereby declare the nature of this invention and in what manner the same is to be performed to be particularly described and ascertained in and by the following statement:—

The object of this invention is to prepare active ferment cells, known as Moto, and Moyashi, in a healthier condition than by the old process, and, also, to preserve moyashi, thus produced, in a healthier condition for a longer period of time than has hitherto been done; and, further, to ferment alcoholic liquors of a greater percentage of alcohol than has hitherto been done, and of any desired strength under twenty *per cent.* of alcohol.

In preparing moyashi by the old process, the semi-cleaned steamed rice, is mixed with ash of a certain tree before adding seed ferment and the subsequent processes. The object of adding tree ash is to supply the want of nourishing ingredients necessary for the growth of the ferment; but the composition of ashes being variable (differing with the different parts of the tree) a healthy growth of ferment could not be depended upon.

I discovered that the ferment cells grow and flourish to their highest stage by supplying the proper ingredients for their nourishment in proper quantities and proportions. Otherwise the ferment cells are unhealthy and less productive. I, also, discovered that these proportions and quantities of the ingredients to be supplied vary with the different kinds of cereals or other similar substances used.

To overcome the defects in the old system, I use an artificial mixture of ingredients necessary for the growth and maturity of the ferment. These ingredients are:—

Ammonium salts, preferably of organic acid, say tartrate or other nitrogenous compound, or it may be ammonium phosphate.

Potassium salts, preferably sulphate or phosphate.

Magnesium salts, preferably magnesium sulphate.

Calcium salts, preferably sulphate or phosphate.

Phosphates, preferably calcium or potassium phosphates.

Alkaline hydrate or carbonate, preferably potassium hydrate or carbonate.

The following gives the composition of a suitable mixture for use with rice.

46·3 parts of potassium sulphate (K_2SO_4) which contains 25 parts of potassium oxide (K_2O).

41·8 parts of mono-calcic phosphate ($CaH_4P_2O_8$) which contains 10 parts of calcium oxide (CaO) and besides it contains 25·4 parts of phosphoric acid (P_2O_5).

50·0 parts of magnesium sulphate ($MgSO_4$) which contains 10 parts of magnesium oxide (MgO).

56·8 parts of tri-sodic phosphate (anhydrous) ($Na_6P_2O_8$) which contains 24·6 parts of phosphoric acid (P_2O_5) which when added to 25·4 parts of phosphoric acid (P_2O_5) contained in mono-calcic phosphate, will make up the 50 parts of phosphoric acid (P_2O_5) required for rice.

9·4 parts of ammonium sulphate $(NH_4)_2SO_4$ which contains 2 parts of nitrogen (N).

The proportions of these ingredients for fertilizing rice when expressed in percentage, are as follows:—

22·7 % potassium sulphate K_2SO_4.
20·5 % mono-calcic phosphate $CaH_4P_2O_5$.

[*Price 6d.*]

24·4 % magnesium sulphate $MgSO_4$.
27·8 % tri-sodic phosphate $Na_6P_2O_8$.
4·6 % ammonium sulphate $(NH_4)_2SO_4$.
100·0

The proportions of these ingredients may be varied so as to contain their principal components in about the following quantities :—

25 to 35 parts of potassium oxide (K_2O).
10 to 30 parts of calcium oxide (CaO).
10 to 30 parts of magnesium oxide (MgO).
50 to 75 parts of phosphoric acid (P_2O_5).
2 to 10 parts of ammonia or nitrogen (NH_3 or N).

These mixtures are made slightly alkaline by potassium hydrate or carbonate.

The quantity to be used with cereals *etc.*, varies, and may be one *per cent.*, two *per cent.*, three *per cent.*, four *per cent.*, *etc.*, &c. of the weight of the grain.

Any grain may be used for cultivating moyashi, but the proportions of the ingredients in the above formula may be varied somewhat depending upon the particular grain used. The several grains have been analysed and their chemical constituents are known, and the variations in the proportions of the above formula should be made to supply a particular grain with any of the several chemical elements in which it may be more or less deficient. For rice, the first column of figures in the above formula set out represent the proper proportions. Corn requires a greater proportion of phosphoric acid. The same grains may vary somewhat, and the most useful and successful results must depend upon the experience and observation of the operator and chemist in determining the proportions. I do not limit myself to the exact ingredients mentioned, as there are other elements which may be regarded as the chemical equivalents of the ingredients named, and which may perform suitably the same function in connection with the other ingredients.

These ingredients may be dissolved in water and sprayed over the cereals uniformly, or the cereals (either before or after being steamed) may be plunged into a solution made to a proper strength ; or these ingredients may be mixed with inert substances, such as roasted starch, &c. so as to increase the volume, and sprinkle uniformly over and well mix with, the cereals or other similar substance used.

After the cereals &c. have been impregnated with these mixtures, the ferment spores are added, and the subsequent processes are carried on with usual and due precaution. By this means a better and more uniform moyashi is obtained than by the old methods.

The moyashi thus prepared is a grain or cereal, with a green mould, and this was the form in which it was used both in the manufacture of koji and alcoholic liquors.

The old method of simply placing this article in paper bags, for preservation and transportation was subject to the following serious disadvantages or defects.

During the process of preservation the moisture in the article itself and in the air, as well as the undecomposed starch in the moyashi, reacted on the ferment cells and produced the acid and other injurious fermentations, causing the decay of the moyashi, or making it bad ; consequently the preservation of moyashi for any length of time or its transportation for long distances without damage, was impossible.

By my process, the moyashi, prepared as above, is dried, either by desiccating substances, such as strong sulphuric acid or anhydrous calcium chloride in the usual desiccating process at a temperature below 15° Centigrade. Then it is sifted through a fine sieve, and the grains separated from the green powder, which constitutes the seed ferment cells.

The green powder thus prepared is again dried by the above process, and is then sealed in an air tight vessel, or is mixed with inert, and at the same time hygroscopic substances, such as roasted starch, or anhydrous calcium sulphate.

The objects of mixing these ingredients are twofold :—

1st. To increase the volume so as to be convenient for sprinkling over cereals in koji making.

2nd. To keep the ferment cells always dry; to prevent any possibility of a change from a dormant state to a state of activity; or, the plain green powder, when kept sealed, may be surrounded by the above mentioned hygroscopic substances to prevent any possibility of absorbing moisture.

Moto (a liquor containing active ferment cells, which is used in the process of alcoholic fermentation) in the ordinary way, is made by using steamed rice and rice koji, (which may be prepared as hereinafter described) in certain proportions, with water, and the mixture is exposed to the air, with occasional stirrings, at the natural winter temperature for five or six days, and after that period the temperature of the mixture is raised by placing in it a tub containing nearly boiling water.

The defects of the old system are :—

1. The grain is limited to rice koji only, and is used in its natural size.
2. The absorption of oxygen from the air is very s[illegible]
3. The temperature of the mixture is very irregular, and, therefore, an irregular and incomplete growth of the cells results, and it is also subject to injurious fermentations.

In my process for making moto, any cereals or other starch-containing substances may be used.

In the preparation and production of moto by my process, I employ koji, as one of the elements or factors. Koji may be made from any grains, cereals, or other starch-containing substances, or substances which supply the necessary ingredients for the growth of the ferment. The koji used in my process is preferably made from pure moyashi. The amount of this pure moyashi used constitutes about one-fifty thousandth ($\frac{1}{50000}$) part of the weight of the grain used.

Heretofore in the process of making koji, the unbroken grain of rice has been used, but in my process, I am enabled to employ all the grains, as above stated, and to produce a much better article of koji more economically.

I cause to be crushed and comminuted the grain employed, and then steam it until the starchy matter has been gelatinized by the breaking of the starch cells. The mass is then permitted to cool, until it attains a temperature of about 30° Centigrade, when I place in the same the required quantity of moyashi, which is then thoroughly mixed with the grain, the particles of the mass in this condition retaining the shape of the comminuted particles of grain, and the moyashi is intended to be mixed throughout, care being taken to prevent the compression of the particles of this grain, so that a free circulation of air throughout the mass exists.

The mass thus mixed is placed in a chamber having a temperature ranging from about 20° to 40° Centigrade, though I prefer a temperature of about 30°. The temperature of the room must be determined somewhat by the quantity of the mass employed at the time. The growth of the koji cells that takes place generates some heat in the chamber, and care must be taken to govern the temperature of said chamber accordingly. After remaining for about twenty-four hours, the mass may be and preferably is, spread out in a thin layer.

The mass is allowed to remain in this condition until the koji ferment cell develops, which is generally indicated by the formation of a white mould over and through the same. The same is then taken out and kept in a temperature of not more than 15° C., in order to preserve the same and prevent the further growth of the ferment cell, when it is in condition to be used.

Koji has a diastic power, or the power of converting starch into sugar in the process of making alcohol. It may be used in combination with malt and the small grains, as the latter are now employed, as a diastase in making the conversion, but koji possesses the diastic power or quality of making the conversion without the aid of, or combination with, malt and the small grains, and it may be used alone, without reference to them or either of them.

Instead of thus preserving the koji ferment cells, supported upon the gelatinized particles of grain as above stated, the mass may, after the ferment cells have been properly treated, as set forth, be steeped in water for from three to twelve hours, depending upon the nature and character of the grains employed for its production, the temperature of the water being not over 20° Centigrade, and the proportion of water being about three times the weight of the mass employed.

The mass is mechanically stirred so that the comminuted particles of the gelatinized grains rub against each other, and the outer growth of koji ferment cells which contains the ferment and diastase in the greatest quantities, rubs off and is carried and held in the water while the central portion of the comminuted particles of grain, which may be unconverted starch or may be comparatively less active, either as ferment as diastase, remains as a solid particle.

The liquid containing the koji ferment cells is separated from the solid particles and may be employed either as a diastase for the conversion of starch into sugar in the manufacture of alcoholic liquors, or as a ferment giving material in the manufacture of moto, or it may be used both as a diastase and as a ferment giving material at the same time.

The solid particles separated from the liquid portion by straining and washing, may be used as other grain in the process of manufacturing alcoholic liquor.

The koji thus prepared, either in the mass or as a liquid, contains alcoholic ferment, and also diastase, and acts both as a ferment for alcoholic fermentation and, as a diastase for converting starch into sugar. It takes the place of malt in the process of converting starch into sugar in the manufacture of alcoholic liquors, and it takes the place of yeast after due treatment of the moto process.

The next step in the production of moto is to mix koji and gelatinized starch, or koji, gelatinized starch and sugars; or koji, malt and gelatinized starch; or koji, malt, gelatinized starch and sugars; or malt and koji; or malt, koji and sugars; in fact any combination of one or all of these ingredients with koji.

The above ingredients are mixed in the following proportions; *viz.*:—

Two parts of koji to three, four or five parts of the other ingredients, or the mixture of the other ingredients by weight. This mixture is then ground or crushed into a homogeneous soft paste, with the addition of water, or malt extract, by the use of mills, rollers, or other means, whereby the diastase and the ferment cells can more readily and more uniformly act on the ingredients contained in the mixture; thus occasioning a more uniform and better growth of the cells.

During the process of crushing and grinding, the absorption of oxygen from the air is carried on more successfully, and more completely than by the old process, and in order to insure a proper absorption of the necessary amount of air, the thin paste thus obtained is then placed in a convenient vessel and there stirred for a sufficient period to allow it to absorb the necessary and proper amount of air.

After this has been done, the mixture is placed in a temperature of about 25° to 40° Centigrade, and agitated by frequent stirrings until it acquires a proper condition of maturity.

By the process above described the maturity of the ferment cell is greatly accelerated, and the process being uniform throughout, much better results are attained. The mixture thus treated and obtained is what I call moto.

The indications of the maturity of the ferment cells and of the moto are matters of common knowledge, and, are readily distinguished by those skilled in the art of fermentation.

The moto thus prepared requires the employment of a much less quantity of grain, is produced in much less time, and with greater certainty as to results; contains about three times greater a number of ferment cells to a given weight or bulk, and is consequently much more efficient and active as a ferment; and it can be preserved and utilized much better and longer than moto made by the old process.

Liquors fermented by European vinous yeast produce no more than five or six *per cent.* of alcohol for every hundred parts of fermentable liquor. Therefore, say, in the manufacture of whiskey, in order to obtain six parts of alcohol, one hundred parts of liquor have to be dealt with all through the process.

By my new process, I produce, by direct fermentation, a liquor containing 15 to 20 °/$_0$ of alcohol. Thus in order to get the same quantity of alcohol as before, I have to deal only with the third part of the liquor. Thus the cost of labour and fuel, the amount of capital and the size of the manufacturing plant are reduced to one-third, or thereabouts, or a given sized work can produce three times as much alcohol as by the old process with the same, or nearly the same working expenses.

The further object of this invention is to ferment liquor of about 20 °/$_0$ of alcohol as above and afterwards dilute it to any desired strength by the addition of water or other ingredients.

To carry out this part of my invention the substance to be fermented, say mash, is made into such strength or composition that the starch or sugars (glucose, dextrine *etc.*,) contained in it when converted into alcohol, produce the desired strength of alcohol. The materials to be fermented may be in soluble condition or may be in a partly soluble and partly insoluble condition, which, however, as the fermentation goes on, dissolve and form soluble sugars; or, the materials to be fermented may be added fractionally as the fermentation goes on.

The fermentable material may be sugars or malt solution, or gelatinized starch, or a mixture of malt sugars and koji; or a mixture of koji, malt and gelatinized starch; or a mixture of koji and gelatinized starch.

In order to ferment these materials, an active ferment contained in the koji or moto, or a mixture of moto and koji, or a mixture of ordinary yeast and moto, or a mixture of koji, moto and yeast, or a mixture of yeast and koji is added.

The ferment-containing materials, and the material or materials, or the mixture of materials to be fermented may be mixed together either all at once or fractionally. The object of mixing them fractionally is to keep the sugars in the solution at a suitable strength, which lessens the time of fermentation.

The proportion of mixing the ferment-containing materials varies according to the nature of the fermentable materials, and they may be mixed in the proportion of five *per cent.*, ten *per cent.*, fifteen *per cent.* &c. These ferment-containing materials may be either added all at once, or fractionally, to the fermentable materials.

The fermentation is carried on with ordinary precaution. The fermented liquor resulting from the above described koji, moto and other materials will contain from fifteen to twenty *per cent.* of alcohol, instead of from five to six as used by the old process.

If the object is for strong or distilled alcoholic liquors, such as whiskey, rum, gin &c. the fermented liquor is subjected to the process of distillation. When the fermentation is for weaker beverages, such as, beer, ale, porter &c. the fermentable liquor is previously treated to suit its respective object, such as boiling with hops, or scorching of grain, and afterwards diluted with water to its desirable alcoholic strength, and then charged with air or carbonic acid gas, if required.

Having now particularly described and ascertained the nature of my said invention, and in what manner the same is to be performed I declare that what I claim is:—

1. The hereinbefore described composition of matter, to be used as an artificial food and fertilizer, of moyashi or ferment cells consisting of ammonium salts, potassium salts, magnesium salts, calcium salts and phosphates in the proportions specified, all substantially as set forth.

2. The hereinbefore described composition of matter to be used as an artificial

food and fertilizer of moyashi or ferment cells, consisting of ammonium salts, potassium salts, magnesium salts, and phosphates combined in such proportions as to contain their principal components in about the following quantities *viz.* :—

25 to 35 parts of potassium oxide (K_2O)
10 to 30 parts of calcium oxide (CaO)
10 to 30 parts of magnesium oxide (MgO)
50 to 70 parts of phosphoric acid (P_2O_5)
2 to 10 parts of ammonia or nitrogen (NH_3 or N)

all substantially as set forth.

3. The process of growing or developing moyashi or ferment cells with artificial supplies of its proper food which consists (1) in impregnating or saturating the natural grain with an artificial supply of the proper food of moyashi or ferment cells; (2) scattering or planting the spores of moyashi or ferment cells upon the grain thus impregnated or saturated; (3) subjecting the grain and spores thus treated to the proper and even temperature for the growth and development of said moyashi or ferment cells, until the grains are covered with said moyashi or ferment cells, and the latter have reached their maturity; (4) drying said grain and coating of moyashi or ferment cells, and removing and separating the moyashi or ferment cells from the grain by agitation and sifting; all substantially as set forth.

4. The process of growing or developing moyashi or ferment cells with artificial supplies of its proper food which consists (1) in impregnating or saturating the natural grain with an artificial supply of a proper food composed as follows:— Ammonium salts, potassium salts, magnesium salts, calcium salts and phosphates, said ingredients being combined in such proportions as to contain their principal components in about the following quantities:—

25 to 35 parts of potassium oxide (K_2O)
10 to 30 parts of calcium oxide (CaO)
10 to 30 parts of magnesium oxide (MgO)
50 to 70 parts of phosphoric acid (P_2O_5)
2 to 10 parts of ammonia or nitrogen (NH_3 or N);

(2) scattering or planting spores of moyashi or ferment cells upon the grain thus impregnated or saturated; (3) subjecting said grain and spores thus treated to a proper and even temperature for the growth and development of moyashi or ferment cells until the grains are covered with said moyashi or ferment cells and the latter have reached their maturity; (4) drying said grain and its growth of moyashi or ferment cells, and removing and separating the latter from said grain by agitation and sifting, substantially as described.

5. The process of growing or developing moyashi or ferment cells with artificial supplies of its proper food which consists (1) in the impregnating or saturating of the natural grain with an artificial supply of the proper food of moyashi or ferment cells; (2) scattering or planting the spores of moyashi or ferment cells upon the grain thus impregnated or saturated; (3) subjecting said grain and spores thus treated to a proper and even temperature for the growth and development of said moyashi or ferment cells until the grains are covered with said moyashi or ferment cells, and the latter have reached their maturity; (4) drying said grain and coating of moyashi or ferment cells, and removing and separating the moyashi or ferment cells from the grain by agitation and sifting; then again drying the moyashi or ferment cells and mixing with it an inert hygroscopic substance and sealing it in air tight vessels, all substantially as described.

6. The process of preserving moyashi or ferment cells which consists in thoroughly drying the same after they have been separated from the grain into a fine powder; mixing the same with any inert hygroscopic substance, and sealing in air tight vessels, all substantially as described.

7. As an article of commerce, moyashi or ferment cells in the form of a dry green powder composed of dormant ferment cells, substantially as described,

8. As an article of commerce, moyashi or ferment cells in the form of a dry powder composed of dormant vital cells mixed with an inert hygroscopic material, and sealed in air tight vessels, all substantially as described.

9. The process of producing moto, which consists in mixing and combining koji with gelatinized starch, or gelatinized starch and sugars; or with malt, gelatinized starch; or malt, gelatinized starch and sugars; or with malt, or with malt and sugars; or with any combination of one or all of said ingredients; then grinding or crushing said ingredients into a homogeneous soft paste, with the addition of water or malt extract, and completing the mixing of the ingredients, and agitation of the mixture by stirring until the whole has been thoroughly and repeatedly in all its parts exposed to the air; then placing the mass in a temperature of from about 25° to 40° Centigrade and agitating the same by frequent stirrings until it acquires a proper condition of maturity, all substantially as described.

10. The process of producing moto which consists; (1) in mixing with a mass of broken and comminuted grain or starch-containing substances which has been steamed until the starchy matter has been gelatinized by the breaking of the starch cells, about one-fifty thousandth part in weight of pure moyashi, and then thoroughly mixing the same throughout the mass of comminuted grains; then placing and keeping the mass in a temperature of about 20° to 40° Centigrade until the koji ferment cells is matured; (2) mixing this mass containing the matured koji ferment cells with gelatinized starch; or with malt, gelatinized starch and sugars; or with malt; or with malt and sugars; or with any combination of these ingredients in the proportions of two parts of the mass containing the koji ferment cells to three, four or five parts of the other ingredients or the mixture of the other ingredients by weight; then grinding or crushing the mass into a homogeneous soft paste with the addition of water or malt extract, and completing the mixing of the ingredients and the agitation of the mass by stirring until the whole of its parts have been thoroughly and repeatedly exposed to the air; then placing and keeping the same in a temperature of from about 20° to 40° Centigrade and agitating the same by frequent stirring until it acquires a proper condition of maturity; all substantially as described.

11. As an article of commerce, moto—a paste or liquid composed of water and alcohol with some residuum of gelatinized starch, sugars and fibre, and containing uniformly and fully throughout its entire mass active ferment cells; all substantially as described.

12. As an article of commerce, moto—a paste or liquid composed of water and alcohol with some residuum of gelatinized starch, sugars and fibre, and containing active ferment cells, said moto being prepared from gelatinized starch, or gelatinized starch and sugar, or malt and gelatinized starch; or malt, gelatinized starch and sugars; or from any combination of one or all of said ingredients mixed with a mass of comminuted particles of grain or starchy substances in a gelatinized state, said mass of comminuted particles being first supplied with moyashi and treated until it is permeated with fully developed koji ferment cells, all substantially as described.

13. The process of preparing and producing koji which consists in mixing with a mass of broken and comminuted grain or starch-containing substances, which has been steamed until the starchy matter has been gelatinized by the breaking of the starch cells, about one-fifty-thousandth part in weight of pure moyashi, thoroughly mixing the same throughout the mass of comminuted grains then placing and keeping the mass in a temperature of about 20° to 40° Centigrade until the koji ferment cells mature, all substantially as described.

14. As an article of commerce, koji—composed of comminuted particles of grain or starchy substances in a gelatinized state, the mass being covered and permeated with the koji ferment cells growing upon and adhering to the surfaces of the comminuted particles, all substantially as described.

15. The process of preparing and producing pure koji which consists first in

mixing with a mass of broken and comminuted grain or starch-containing substances which has been steamed until the starchy matter has been gelatinized by the breaking of the starch cells, about one-fifty thousandth part in weight of pure moyashi thoroughly mixing the same throughout the mass of comminuted grains, then placing and keeping the mass in a temperature of about 20° to 40° Centigrade until the koji ferment cells are matured; (2) steeping this mass of comminuted particles with their koji ferment cells in water for from three to twelve hours, according to the nature of the grain employed for its production at a temperature of not over 20° Centigrade, the proportion of water being about twice to three times the weight of the koji mass employed, stirring the mass mechanically in the water until by attrition the koji ferment cells are freed from the comminuted particles of grain and float and are carried in the water, then drawing off the water containing the pure koji ferment cells; all substantially as described.

16. As an article of commerce, a thin liquid paste consisting of water holding in suspension throughout all its parts koji ferment cells, said water also holding in solution a slight percentage of gelatinized starch, all substantially as described.

17. The process of making a fermentable wash or liquor, which consists in adding koji to a liquor containing gelatinized starch and sugars, or gelatinized starch alone, whereby the starch is converted into sugar; all substantially as described.

18. The process of making a fermentable wash or liquor which consists in adding koji to a liquor containing gelatinized starch and sugars or gelatinized starch alone, to which malt and small grains have also been added, whereby the starch is converted into sugar, all substantially as described.

19. The process of making a fermented liquor which consists in fermenting a fermentable wash or liquor by the addition of moto, or moto and yeast, or yeast, all substantially as described.

20. The process of making a fermented liquor which consists in adding a fermentable liquor prepared by the introduction of koji to a ferment-containing liquor prepared by the introduction of moto, or moto and yeast, or yeast; the addition being made fractionally as the fermentation proceeds in order to keep the solution at the desired strength; all substantially as described.

21. The process of making alcoholic liquor which consists in fermenting a fermentable wash or liquor by the introduction of moto, or moto and yeast or yeast and distilling the product, all substantially as described.

22. The process of making alcoholic liquor which consists in fermenting a fermentable wash or liquor prepared by the introduction of koji, by adding it fractionally to a ferment-containing wash or liquor prepared by the introduction into a wash or liquor of moto or moto and yeast or yeast; said addition to the ferment-containing liquor being made fractionally as the fermentation proceeds in order to keep the solution up to the desired strength, and distilling the product; all substantially as described.

23. The process of making a fermented liquor which consists in fermenting a fermentable wash or liquor which has been treated by the introduction of hops, scorched grain or similar material, by the addition thereto of moto, or moto and yeast, or yeast; then diluting the same to the required strength; all substantially as described.

Dated this 2nd day of April 1891.

JOKICHI TAKAMINE,
By L. W., per F. B.

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COMPLETE SPECIFICATION.

Improvements in the Production of Ferments and of Fermented Alcoholic Liquors.

I, Jokichi Takamine, of 25 & 26 Honore Buildings Chicago, County of Cook, State of Ilinois, United States of America, Chemist, do hereby declare the nature of this invention and in what manner the same is to be performed to be particularly described and ascertained in and by the following statement :—

The object of this invention is to prepare active ferment cells, known as Moto and Moyashi, in a healthier condition than by the old process, and, also, to preserve moyashi, thus produced, in a healthier condition for a longer period of time than has hitherto been done; and, further, to ferment alcoholic liquors of a greater percentage of alcohol than has hitherto been done, and of any desired strength under twenty *per cent.* of alcohol.

In preparing moyashi by the old process, the semi-cleaned steamed rice, is mixed with ash of a certain tree before adding seed ferment and the subsequent processes. The object of adding tree ash is to supply the want of nourishing ingredients necessary for the growth of the ferment; but the composition of ashes being variable (differing with the different parts of the tree) a healthy growth of ferment could not be depended upon.

I discovered that the ferment cells grow and flourish to their highest stage by supplying the proper ingredients for their nourishment in proper quantities and proportions. Otherwise the ferment cells are unhealthy and less productive. I, also, discovered that these proportions and quantities of the ingredients to be supplied vary with the different kinds of cereals or other similar substances used.

To overcome the defects in the old system, I use an artificial mixture of ingredients necessary for the growth and maturity of the ferment. These ingredients are :—

Ammonium salts, preferably of organic acid, say tartrate or other nitrogenous compound, or it may be ammonium phosphate.

Potassium salts, preferably sulphate or phosphate.

Magnesium salts, preferably magnesium sulphate.

Calcium salts, preferably sulphate or phosphate.

Phosphates, preferably calcium or potassium phosphates.

Alkaline hydrate or carbonate, preferably potassium hydrate or carbonate.

The following gives the composition of a suitable mixture for use with rice.

46·3 parts of potassium sulphate (K_2SO_4) which contains 25 parts of potassium oxide (K_2O).

41·8 parts of mono-calcic phosphate ($CaH_4P_2O_8$) which contains 10 parts of calcium oxide (CaO) and besides it contains 25·4 parts of phosphoric acid (P_2O_5).

50·0 parts of magnesium sulphate ($MgSO_4$) which contains 10 parts of magnesium oxide (MgO).

56·8 parts of tri-sodic phosphate (anhydrous) ($Na_6P_2O_8$) which contains 24·6 parts of phosphoric acid (P_2O_5) which when added to 25·4 parts of phosphoric acid (P_2O_5) contained in mono-calcic phosphate, will make up the 50 parts of phosphoric acid (P_2O_5) required for rice.

9·4 parts of ammonium sulphate $(NH_4)_2SO_4$ which contains 2 parts of nitrogen (N).

The proportions of these ingredients for fertilizing rice when expressed in percentage, are as follows :—

22·7 % potassium sulphate K_2SO_4.
20·5 % mono-calcic phosphate $CaH_4P_2O_8$.

[*Price 6d.*]

24·4 °/o magnesium sulphate $MgSO_4$.
27·8 °/o tri-sodic phosphate $Na_6P_2O_8$.
4·6 °/o ammonium sulphate $(NH_4)_2SO_4$.
100·0

The proportions of these ingredients may be varied so as to contain their principal components in about the following quantities :—

25 to 35 parts of potassium oxide (K_2O).
10 to 30 parts of calcium oxide (CaO).
10 to 30 parts of magnesium oxide (MgO).
50 to 75 parts of phosphoric acid (P_2O_5).
2 to 10 parts of ammonia or nitrogen (NH_3 or N).

These mixtures are made slightly alkaline by potassium hydrate or carbonate.

The quantity to be used with cereals *etc.*, varies, and may be one *per cent.*, two *per cent.*, three *per cent.*, four *per cent.*, *etc.*, &c. of the weight of the grain.

Any grain may be used for cultivating moyashi, but the proportions of the ingredients in the above formula may be varied somewhat depending upon the particular grain used. The several grains have been analysed and their chemical constituents are known, and the variations in the proportions of the above formula should be made to supply a particular grain with any of the several chemical elements in which it may be more or less deficient. For rice, the first column of figures in the above formula set out represent the proper proportions. Corn requires a greater proportion of phosphoric acid. The same grains may vary somewhat, and the most useful and successful results must depend upon the experience and observation of the operator and chemist in determining the proportions. I do not limit myself to the exact ingredients mentioned, as there are other elements which may be regarded as the chemical equivalents of the ingredients named, and which may perform suitably the same function in connection with the other ingredients.

These ingredients may be dissolved in water and sprayed over the cereals uniformly, or the cereals (either before or after being steamed) may be plunged into a solution made to a proper strength; or these ingredients may be mixed with inert substances, such as roasted starch, &c. so as to increase the volume, and sprinkle uniformly over and well mix with, the cereals or other similar substance used.

After the cereals &c. have been impregnated with these mixtures, the ferment spores are added, and the subsequent processes are carried on with usual and due precaution. By this means a better and more uniform moyashi is obtained than by the old methods.

The moyashi thus prepared is a grain or cereal, with a green mould, and this was the form in which it was used both in the manufacture of koji and alcoholic liquors.

The old method of simply placing this article in paper bags, for preservation and transportation was subject to the following serious disadvantages or defects.

During the process of preservation the moisture in the article itself and in the air, as well as the undecomposed starch in the moyashi, reacted on the ferment cells and produced the acid and other injurious fermentations, causing the decay of the moyashi, or making it bad; consequently the preservation of moyashi for any length of time or its transportation for long distances without damage, was impossible.

By my process, the moyashi, prepared as above, is dried, either by desiccating substances, such as strong sulphuric acid or anhydrous calcium chloride in the usual desiccating process at a temperature below 15° Centigrade. Then it is sifted through a fine sieve, and the grains separated from the green powder, which constitutes the seed ferment cells.

The green powder thus prepared is again dried by the above process, and is then

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sealed in an air tight vessel, or is mixed with inert, and at the same time hygroscopic substances, such as roasted starch, or anhydrous calcium sulphate.

The objects of mixing these ingredients are twofold:—

1st. To increase the volume so as to be convenient for sprinkling over cereals in koji making.

2nd. To keep the ferment cells always dry; to prevent any possibility of a change from a dormant state to a state of activity; or, the plain green powder, when kept sealed, may be surrounded by the above mentioned hygroscopic substances to prevent any possibility of absorbing moisture.

Moto (a liquor containing active ferment cells, which is used in the process of alcoholic fermentation) in the ordinary way, is made by using steamed rice and rice koji, (which may be prepared as hereinafter described) in certain proportions, with water, and the mixture is exposed to the air, with occasional stirrings, at the natural winter temperature for five or six days, and after that period the temperature of the mixture is raised by placing in it a tub containing nearly boiling water.

The defects of the old system are:—

1. The grain is limited to rice koji only, and is used in its natural size.
2. The absorption of oxygen from the air is very slow.
3. The temperature of the mixture is very irregular, and, therefore, an irregular and incomplete growth of the cells results, and it is also subject to injurious fermentations.

In my process for making moto, any cereals or other starch-containing substances may be used.

In the preparation and production of moto by my process, I employ koji, as one of the elements or factors. Koji may be made from any grains, cereals, or other starch-containing substances, or substances which supply the necessary ingredients for the growth of the ferment. The koji used in my process is preferably made from pure moyashi. The amount of this pure moyashi used constitutes about one-fifty thousandth ($\frac{1}{50000}$) part of the weight of the grain used.

Heretofore in the process of making koji, the unbroken grain of rice has been used, but in my process, I am enabled to employ all the grains, as above stated, and to produce a much better article of koji more economically.

I cause to be crushed and comminuted the grain employed, and then steam it until the starchy matter has been gelatinized by the breaking of the starch cells. The mass is then permitted to cool, until it attains a temperature of about 30° Centigrade, when I place in the same the required quantity of moyashi, which is then thoroughly mixed with the grain, the particles of the mass in this condition retaining the shape of the comminuted particles of grain, and the moyashi is intended to be mixed throughout, care being taken to prevent the compression of the particles of this grain, so that a free circulation of air throughout the mass exists.

The mass thus mixed is placed in a chamber having a temperature ranging from about 20° to 40° Centigrade, though I prefer a temperature of about 30°. The temperature of the room must be determined somewhat by the quantity of the mass employed at the time. The growth of the koji cells that takes place generates some heat in the chamber, and care must be taken to govern the temperature of said chamber accordingly. After remaining for about twenty-four hours, the mass may be and preferably is, spread out in a thin layer.

The mass is allowed to remain in this condition until the koji ferment cell develops, which is generally indicated by the formation of a white mould over and through the same. The same is then taken out and kept in a temperature of not more than 15° C., in order to preserve the same and prevent the further growth of the ferment cell, when it is in condition to be used.

Koji has a diastic power, or the power of converting starch into sugar in the process of making alcohol. It may be used in combination with malt and the small grains, as the latter are now employed, as a diastase in making the conversion, but koji possesses the diastic power or quality of making the conversion without the aid of, or combination with, malt and the small grains, and it may be used alone, without reference to them or either of them.

Instead of thus preserving the koji ferment cells, supported upon the gelatinized particles of grain as above stated, the mass may, after the ferment cells have been properly treated, as set forth, be steeped in water for from three to twelve hours, depending upon the nature and character of the grains employed for its production, the temperature of the water being not over 20° Centigrade, and the proportion of water being about three times the weight of the mass employed.

The mass is mechanically stirred so that the comminuted particles of the gelatinized grains rub against each other, and the outer growth of koji ferment cells which contains the ferment and diastase in the greatest quantities, rubs off and is carried and held in the water while the central portion of the comminuted particles of grain, which may be unconverted starch or may be comparatively less active, either as ferment as diastase, remains as a solid particle.

The liquid containing the koji ferment cells is separated from the solid particles and may be employed either as a diastase for the conversion of starch into sugar in the manufacture of alcoholic liquors, or as a ferment giving material in the manufacture of moto, or it may be used both as a diastase and as a ferment giving material at the same time.

The solid particles separated from the liquid portion by straining and washing, may be used as other grain in the process of manufacturing alcoholic liquor.

The koji thus prepared, either in the mass or as a liquid, contains alcoholic ferment, and also diastase, and acts both as a ferment for alcoholic fermentation and, as a diastase for converting starch into sugar. It takes the place of malt in the process of converting starch into sugar in the manufacture of alcoholic liquors, and it takes the place of yeast after due treatment of the moto process.

The next step in the production of moto is to mix koji and gelatinized starch, or koji, gelatinized starch and sugars; or koji, malt and gelatinized starch; or koji, malt, gelatinized starch and sugars; or malt and koji; or malt, koji and sugars; in fact any combination of one or all of these ingredients with koji.

The above ingredients are mixed in the following proportions; *viz.*:—

Two parts of koji to three, four or five parts of the other ingredients, or the mixture of the other ingredients by weight. This mixture is then ground or crushed into a homogeneous soft paste, with the addition of water, or malt extract, by the use of mills, rollers, or other means, whereby the diastase and the ferment cells can more readily and more uniformly act on the ingredients contained in the mixture; thus occasioning a more uniform and better growth of the cells.

During the process of crushing and grinding, the absorption of oxygen from the air is carried on more successfully, and more completely than by the old process, and in order to insure a proper absorption of the necessary amount of air, the thin paste thus obtained is then placed in a convenient vessel and there stirred for a sufficient period to allow it to absorb the necessary and proper amount of air.

After this has been done, the mixture is placed in a temperature of about 25° to 40° Centigrade, and agitated by frequent stirrings until it acquires a proper condition of maturity.

By the process above described the maturity of the ferment cell is greatly accelerated, and the process being uniform throughout, much better results are attained. The mixture thus treated and obtained is what I call moto.

The indications of the maturity of the ferment cells and of the moto are matters of common knowledge, and, are readily distinguished by those skilled in the art of fermentation.

The moto thus prepared requires the employment of a much less quantity of grain, is produced in much less time, and with greater certainty as to results; contains about three times greater a number of ferment cells to a given weight or bulk, and is consequently much more efficient and active as a ferment; and it can

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be preserved and utilized much better and longer than moto made by the old process.

Liquors fermented by European vinous yeast produce no more than five or six *per cent.* of alcohol for every hundred parts of fermentable liquor. Therefore, say, in the manufacture of whiskey, in order to obtain six parts of alcohol, one hundred parts of liquor have to be dealt with all through the process.

By my new process, I produce, by direct fermentation, a liquor containing 15 to 20 °/₀ of alcohol. Thus in order to get the same quantity of alcohol as before, I have to deal only with the third part of the liquor. Thus the cost of labour and fuel, the amount of capital and the size of the manufacturing plant are reduced to one-third, or thereabouts, or a given sized work can produce three times as much alcohol as by the old process with the same, or nearly the same working expenses.

The further object of this invention is to ferment liquor of about 20 °/₀ of alcohol as above and afterwards dilute it to any desired strength by the addition of water or other ingredients.

To carry out this part of my invention the substance to be fermented, say mash, is made into such strength or composition that the starch or sugars (glucose, dextrine *etc.*,) contained in it when converted into alcohol, produce the desired strength of alcohol. The materials to be fermented may be in soluble condition or may be in a partly soluble and partly insoluble condition, which, however, as the fermentation goes on, dissolve and form soluble sugars; or, the materials to be fermented may be added fractionally as the fermentation goes on.

The fermentable material may be sugars or malt solution, or gelatinized starch, or a mixture of malt sugars and koji; or a mixture of koji, malt and gelatinized starch; or a mixture of koji and gelatinized starch.

In order to ferment these materials, an active ferment contained in the koji or moto, or a mixture of moto and koji, or a mixture of ordinary yeast and moto, or a mixture of koji, moto and yeast, or a mixture of yeast and koji is added.

The ferment-containing materials, and the material or materials, or the mixture of materials to be fermented may be mixed together either all at once or fractionally. The object of mixing them fractionally is to keep the sugars in the solution at a suitable strength, which lessens the time of fermentation.

The proportion of mixing the ferment-containing materials varies according to the nature of the fermentable materials, and they may be mixed in the proportion of five *per cent.*, ten *per cent.*, fifteen *per cent.* &c. These ferment-containing materials may be either added all at once, or fractionally, to the fermentable materials.

The fermentation is carried on with ordinary precaution. The fermented liquor resulting from the above described koji, moto and other materials will contain from fifteen to twenty *per cent.* of alcohol, instead of from five to six as used by the old process.

If the object is for strong or distilled alcoholic liquors, such as whiskey, rum, gin &c. the fermented liquor is subjected to the process of distillation. When the fermentation is for weaker beverages, such as, beer, ale, porter &c. the fermentable liquor is previously treated to suit its respective object, such as boiling with hops, or scorching of grain, and afterwards diluted with water to its desirable alcoholic strength, and then charged with air or carbonic acid gas, if required.

Having now particularly described and ascertained the nature of my said invention, and in what manner the same is to be performed I declare that what I claim is :—

1. The hereinbefore described composition of matter, to be used as an artificial food and fertilizer, of moyashi or ferment cells consisting of ammonium salts, potassium salts, magnesium salts, calcium salts and phosphates in the proportions specified, all substantially as set forth.

2. The hereinbefore described composition of matter to be used as an artificial

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food and fertilizer of moyashi or ferment cells, consisting of ammonium salts, potassium salts, magnesium salts, and phosphates combined in such proportions as to contain their principal components in about the following quantities *viz.*:—

25 to 35 parts of potassium oxide (K_2O)
10 to 30 parts of calcium oxide (CaO)
10 to 30 parts of magnesium oxide (MgO)
50 to 70 parts of phosphoric acid (P_2O_5)
2 to 10 parts of ammonia or nitrogen (NH_3 or N)

all substantially as set forth.

3. The process of growing or developing moyashi or ferment cells with artificial supplies of its proper food which consists (1) in impregnating or saturating the natural grain with an artificial supply of the proper food of moyashi or ferment cells; (2) scattering or planting the spores of moyashi or ferment cells upon the grain thus impregnated or saturated; (3) subjecting the grain and spores thus treated to the proper and even temperature for the growth and development of said moyashi or ferment cells, until the grains are covered with said moyashi or ferment cells, and the latter have reached their maturity; (4) drying said grain and coating of moyashi or ferment cells, and removing and separating the moyashi or ferment cells from the grain by agitation and sifting; all substantially as set forth.

4. The process of growing or developing moyashi or ferment cells with artificial supplies of its proper food which consists (1) in impregnating or saturating the natural grain with an artificial supply of a proper food composed as follows:—Ammonium salts, potassium salts, magnesium salts, calcium salts and phosphates, said ingredients being combined in such proportions as to contain their principal components in about the following quantities:—

25 to 35 parts of potassium oxide (K_2O)
10 to 30 parts of calcium oxide (CaO)
10 to 30 parts of magnesium oxide (MgO)
50 to 70 parts of phosphoric acid (P_2O_5)
2 to 10 parts of ammonia or nitrogen (NH_3 or N);

(2) scattering or planting spores of moyashi or ferment cells upon the grain thus impregnated or saturated; (3) subjecting said grain and spores thus treated to a proper and even temperature for the growth and development of moyashi or ferment cells until the grains are covered with said moyashi or ferment cells and the latter have reached their maturity; (4) drying said grain and its growth of moyashi or ferment cells, and removing and separating the latter from said grain by agitation and sifting, substantially as described.

5. The process of growing or developing moyashi or ferment cells with artificial supplies of its proper food which consists (1) in the impregnating or saturating of the natural grain with an artificial supply of the proper food of moyashi or ferment cells; (2) scattering or planting the spores of moyashi or ferment cells upon the grain thus impregnated or saturated; (3) subjecting said grain and spores thus treated to a proper and even temperature for the growth and development of said moyashi or ferment cells until the grains are covered with said moyashi or ferment cells, and the latter have reached their maturity; (4) drying said grain and coating of moyashi or ferment cells, and removing and separating the moyashi or ferment cells from the grain by agitation and sifting; then again drying the moyashi or ferment cells and mixing with it an inert hygroscopic substance and sealing it in air tight vessels, all substantially as described.

6. The process of preserving moyashi or ferment cells which consists in thoroughly drying the same after they have been separated from the grain into a fine powder; mixing the same with any inert hygroscopic substance, and sealing in air tight vessels, all substantially as described.

7. As an article of commerce, moyashi or ferment cells in the form of a dry green powder composed of dormant ferment cells, substantially as described.

8. As an article of commerce, moyashi or ferment cells in the form of a dry powder composed of dormant vital cells mixed with an inert hygroscopic material, and sealed in air tight vessels, all substantially as described.

9. The process of producing moto, which consists in mixing and combining koji with gelatinized starch, or gelatinized starch and sugars; or with malt, gelatinized starch; or malt, gelatinized starch and sugars; or with malt, or with malt and sugars; or with any combination of one or all of said ingredients; then grinding or crushing said ingredients into a homogeneous soft paste, with the addition of water or malt extract, and completing the mixing of the ingredients, and agitation of the mixture by stirring until the whole has been thoroughly and repeatedly in all its parts exposed to the air; then placing the mass in a temperature of from about 25° to 40° Centigrade and agitating the same by frequent stirrings until it acquires a proper condition of maturity, all substantially as described.

10. The process of producing moto which consists; (1) in mixing with a mass of broken and comminuted grain or starch-containing substances which has been steamed until the starchy matter has been gelatinized by the breaking of the starch cells, about one-fifty thousandth part in weight of pure moyashi, and then thoroughly mixing the same throughout the mass of comminuted grains; then placing and keeping the mass in a temperature of about 20° to 40° Centigrade until the koji ferment cells is matured; (2) mixing this mass containing the matured koji ferment cells with gelatinized starch; or with malt, gelatinized starch and sugars; or with malt; or with malt and sugars; or with any combination of these ingredients in the proportions of two parts of the mass containing the koji ferment cells to three, four or five parts of the other ingredients or the mixture of the other ingredients by weight; then grinding or crushing the mass into a homogeneous soft paste with the addition of water or malt extract, and completing the mixing of the ingredients and the agitation of the mass by stirring until the whole of its parts have been thoroughly and repeatedly exposed to the air; then placing and keeping the same in a temperature of from about 20° to 40° Centigrade and agitating the same by frequent stirring until it acquires a proper condition of maturity; all substantially as described.

11. As an article of commerce, moto—a paste or liquid composed of water and alcohol with some residuum of gelatinized starch, sugars and fibre, and containing uniformly and fully throughout its entire mass active ferment cells; all substantially as described.

12. As an article of commerce, moto—a paste or liquid composed of water and alcohol with some residuum of gelatinized starch, sugars and fibre, and containing active ferment cells, said moto being prepared from gelatinized starch, or gelatinized starch and sugar, or malt and gelatinized starch; or malt, gelatinized starch and sugars; or from any combination of one or all of said ingredients mixed with a mass of comminuted particles of grain or starchy substances in a gelatinized state, said mass of comminuted particles being first supplied with moyashi and treated until it is permeated with fully developed koji ferment cells, all substantially as described.

13. The process of preparing and producing koji which consists in mixing with a mass of broken and comminuted grain or starch-containing substances, which has been steamed until the starchy matter has been gelatinized by the breaking of the starch cells, about one-fifty-thousandth part in weight of pure moyashi, thoroughly mixing the same throughout the mass of comminuted grains then placing and keeping the mass in a temperature of about 20° to 40° Centigrade until the koji ferment cells mature, all substantially as described.

14. As an article of commerce, koji—composed of comminuted particles of grain or starchy substances in a gelatinized state, the mass being covered and permeated with the koji ferment cells growing upon and adhering to the surfaces of the comminuted particles, all substantially as described.

15. The process of preparing and producing pure koji which consists first in

mixing with a mass of broken and comminuted grain or starch-containing substances which has been steamed until the starchy matter has been gelatinized by the breaking of the starch cells, about one-fifty thousandth part in weight of pure moyashi thoroughly mixing the same throughout the mass of comminuted grains, then placing and keeping the mass in a temperature of about 20° to 40° Centigrade until the koji ferment cells are matured; (2) steeping this mass of comminuted particles with their koji ferment cells in water for from three to twelve hours, according to the nature of the grain employed for its production at a temperature of not over 20° Centigrade, the proportion of water being about twice to three times the weight of the koji mass employed, stirring the mass mechanically in the water until by attrition the koji ferment cells are freed from the comminuted particles of grain and float and are carried in the water, then drawing off the water containing the pure koji ferment cells; all substantially as described.

16. As an article of commerce, a thin liquid paste consisting of water holding in suspension throughout all its parts koji ferment cells, said water also holding in solution a slight percentage of gelatinized starch, all substantially as described.

17. The process of making a fermentable wash or liquor, which consists in adding koji to a liquor containing gelatinized starch and sugars, or gelatinized starch alone, whereby the starch is converted into sugar; all substantially as described.

18. The process of making a fermentable wash or liquor which consists in adding koji to a liquor containing gelatinized starch and sugars or gelatinized starch alone, to which malt and small grains have also been added, whereby the starch is converted into sugar, all substantially as described.

19. The process of making a fermented liquor which consists in fermenting a fermentable wash or liquor by the addition of moto, or moto and yeast, or yeast, all substantially as described.

20. The process of making a fermented liquor which consists in adding a fermentable liquor prepared by the introduction of koji to a ferment-containing liquor prepared by the introduction of moto, or moto and yeast, or yeast; the addition being made fractionally as the fermentation proceeds in order to keep the solution at the desired strength; all substantially as described.

21. The process of making alcoholic liquor which consists in fermenting a fermentable wash or liquor by the introduction of moto, or moto and yeast or yeast and distilling the product, all substantially as described.

22. The process of making alcoholic liquor which consists in fermenting a fermentable wash or liquor prepared by the introduction of koji, by adding it fractionally to a ferment-containing wash or liquor prepared by the introduction into a wash or liquor of moto or moto and yeast or yeast; said addition to the ferment-containing liquor being made fractionally as the fermentation proceeds in order to keep the solution up to the desired strength, and distilling the product; all substantially as described.

23. The process of making a fermented liquor which consists in fermenting a fermentable wash or liquor which has been treated by the introduction of hops, scorched grain or similar material, by the addition thereto of moto, or moto and yeast, or yeast; then diluting the same to the required strength; all substantially as described.

Dated this 2nd day of April 1891.

JOKICHI TAKAMINE,
By L. W., per F. B.

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